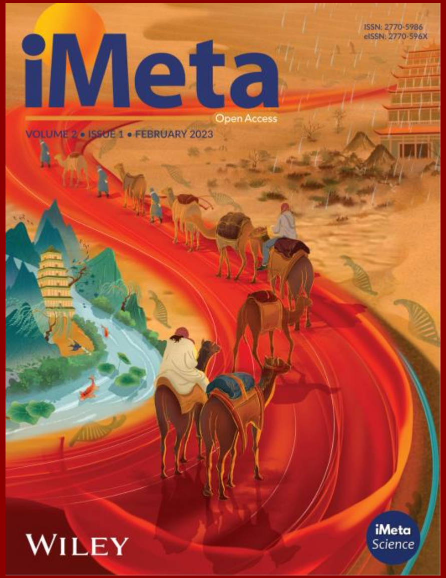
Multi-Omics Insights into Surface Charge Effects to Decode the Interplay of Nanoplastics and Bacterial Antibiotic Resistance



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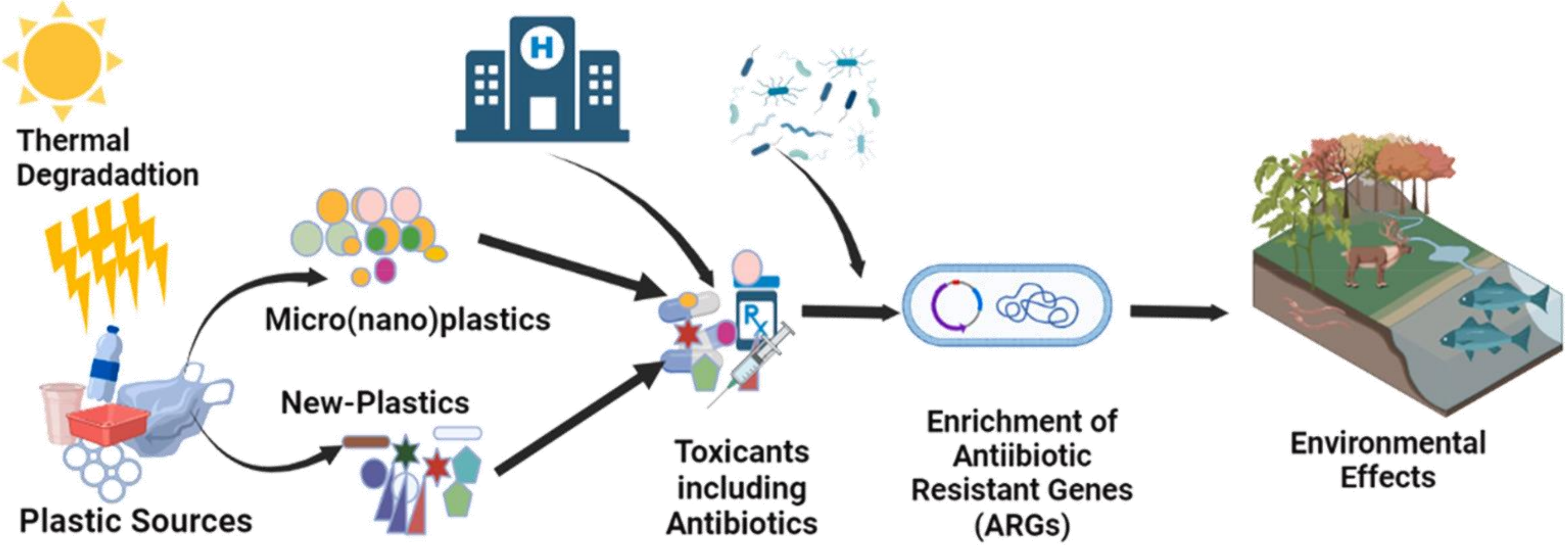
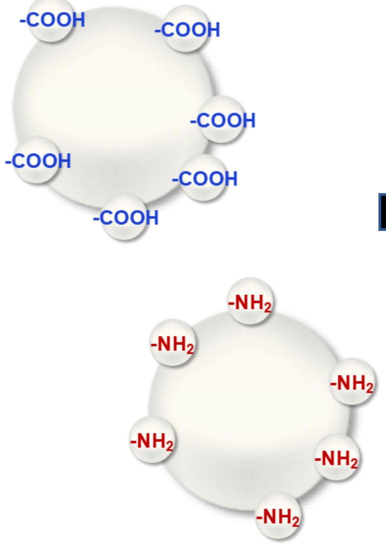
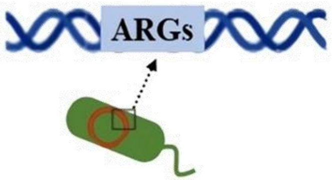
Introduction

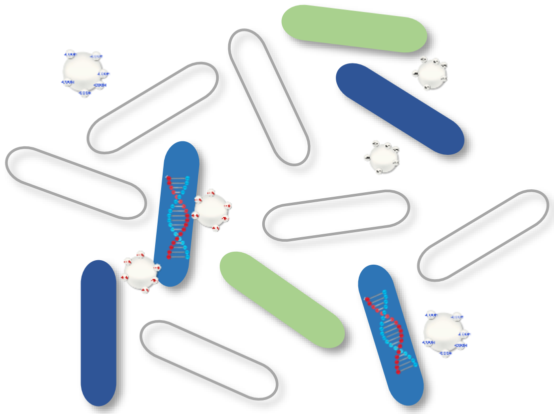
Widespread distribution



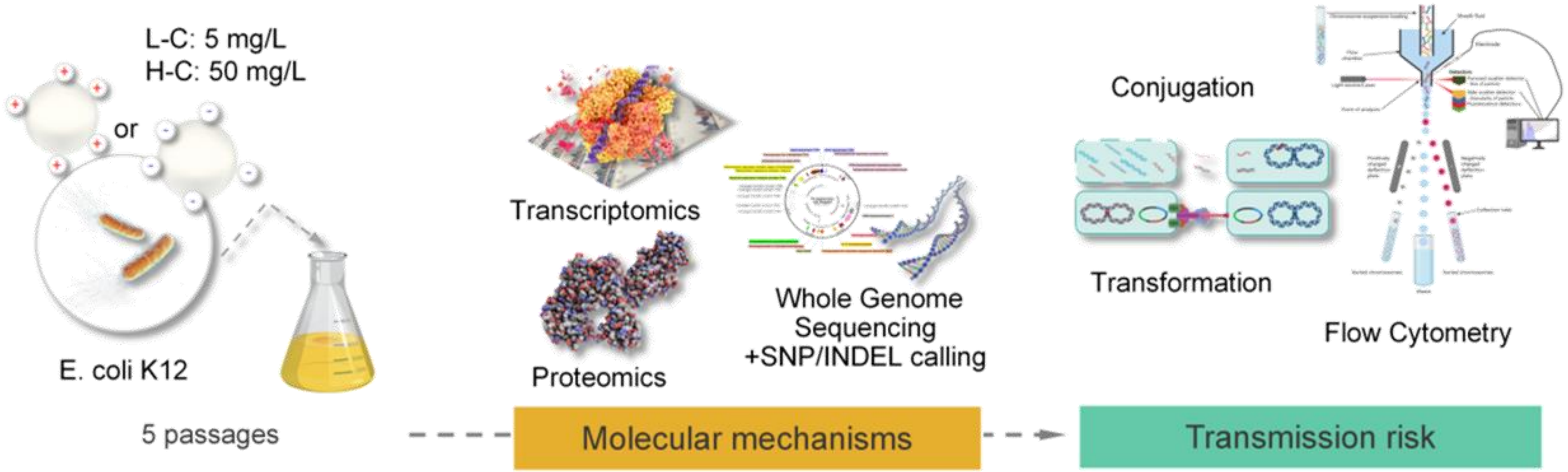
Impacts of nanoplastics with varying surface properties on the modulation of bacterial antibiotic resistance remains unclear.





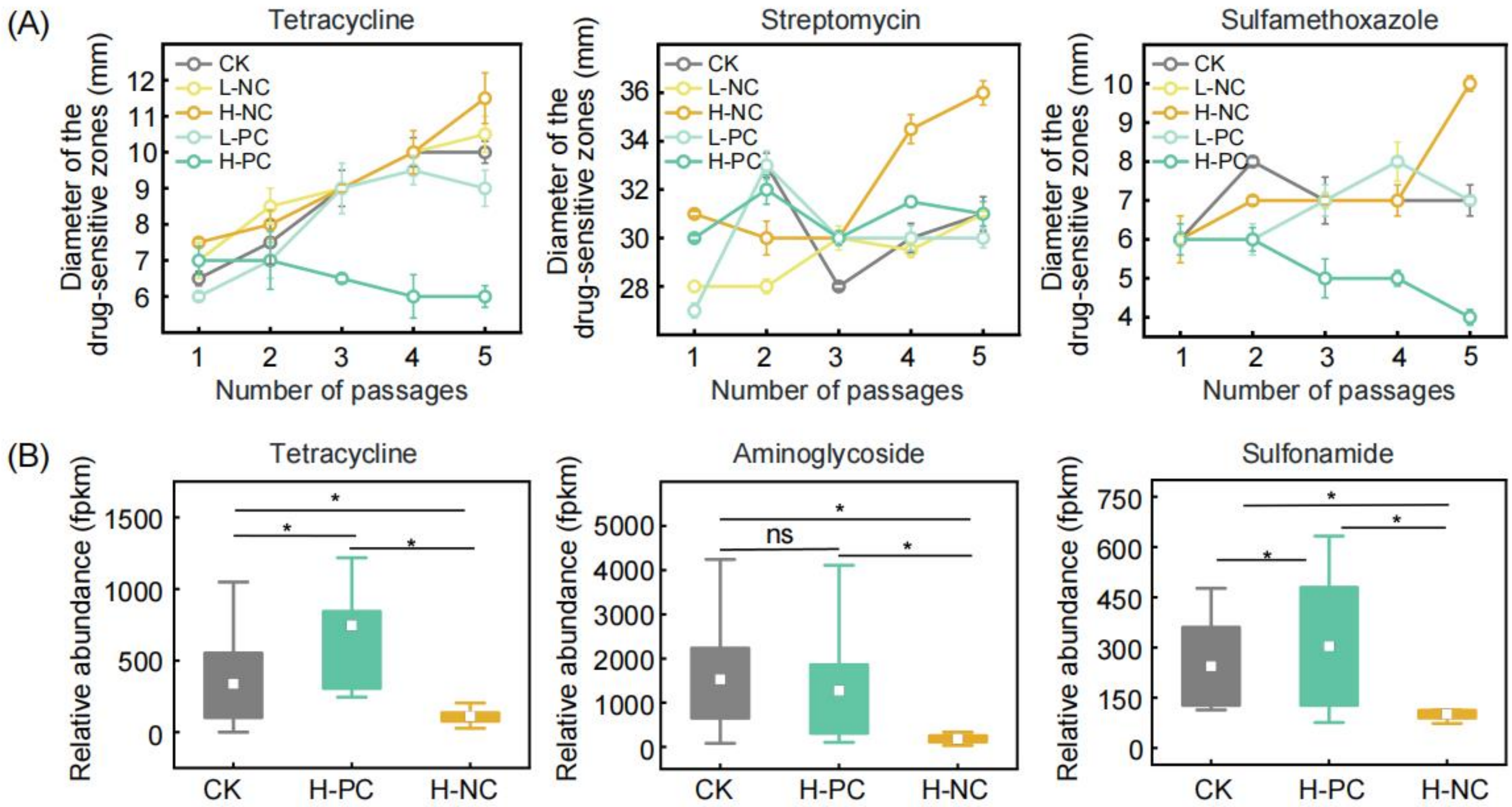


Highlight

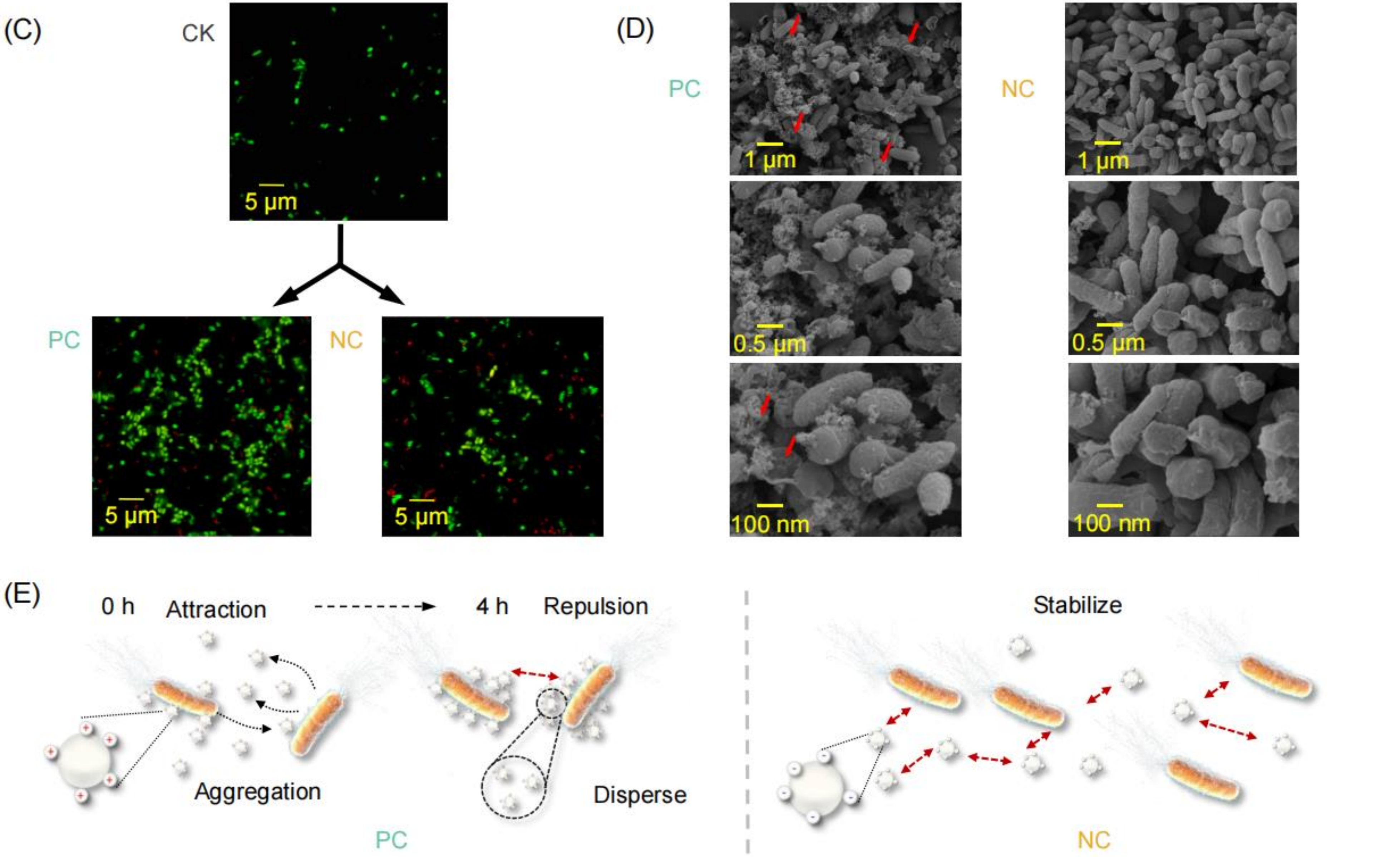


- 1. Multi-omics approaches revealed how nanoplastics with different surface charges influence antibiotic resistance in *Escherichia coli*.
- 2. Positively charged nanoplastics enhanced antibiotic resistance by upregulating genes and proteins linked to oxidative stress tolerance and efflux pumps, and promoted antibiotic resistance genes transfer via conjugation and transformation.
- 3. Negatively charged nanoplastics disrupted biofilm formation and metabolism, potentially reducing antibiotic resistance.
- 4. These findings highlight the critical role of nanoplastics surface properties in shaping microbial resistance dynamics and highlight emerging risks posed by nanoplastics to public health through accelerated antibiotic resistance propagation.

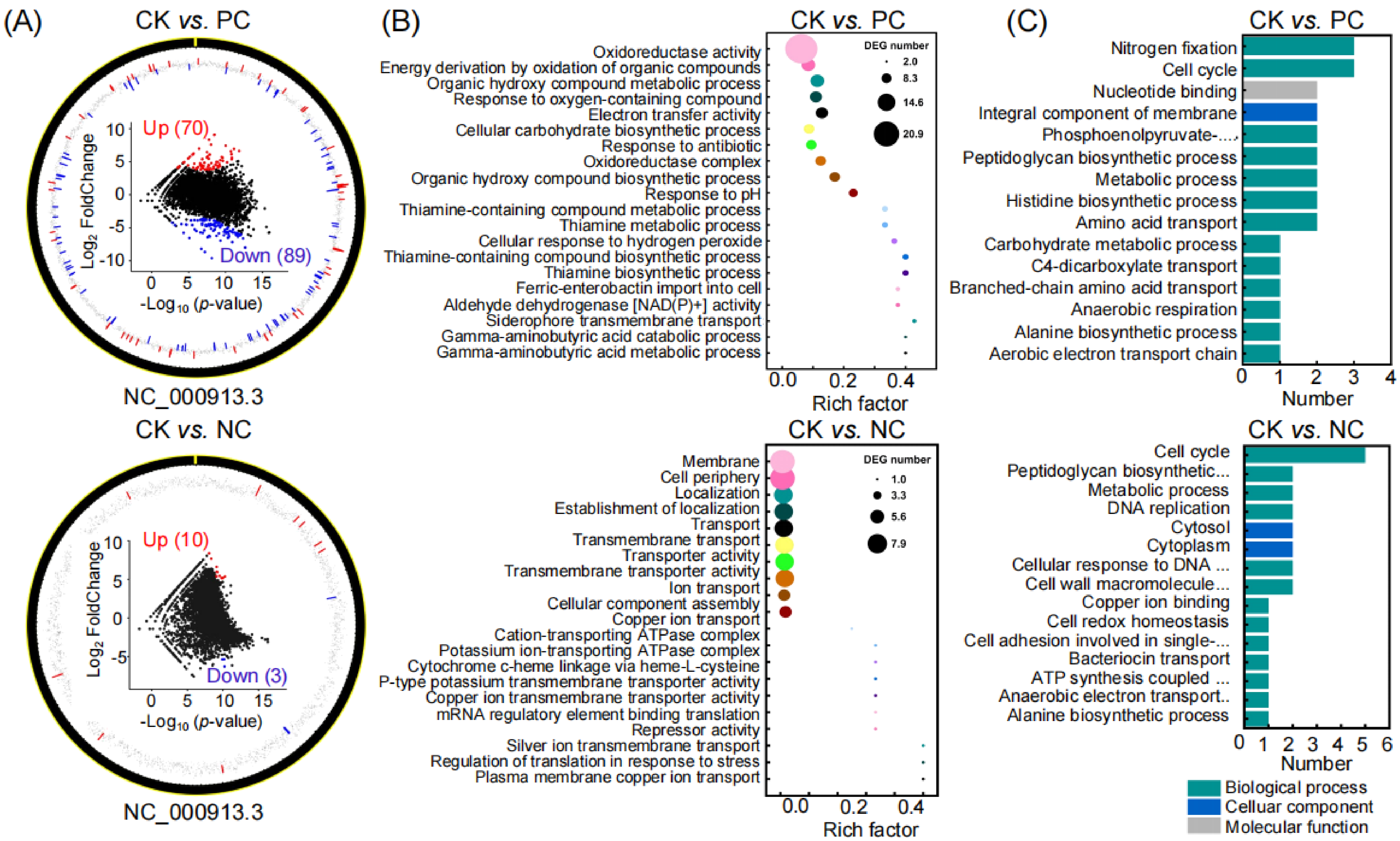
Positively charged NPs enhanced bacterial antibiotic resistance



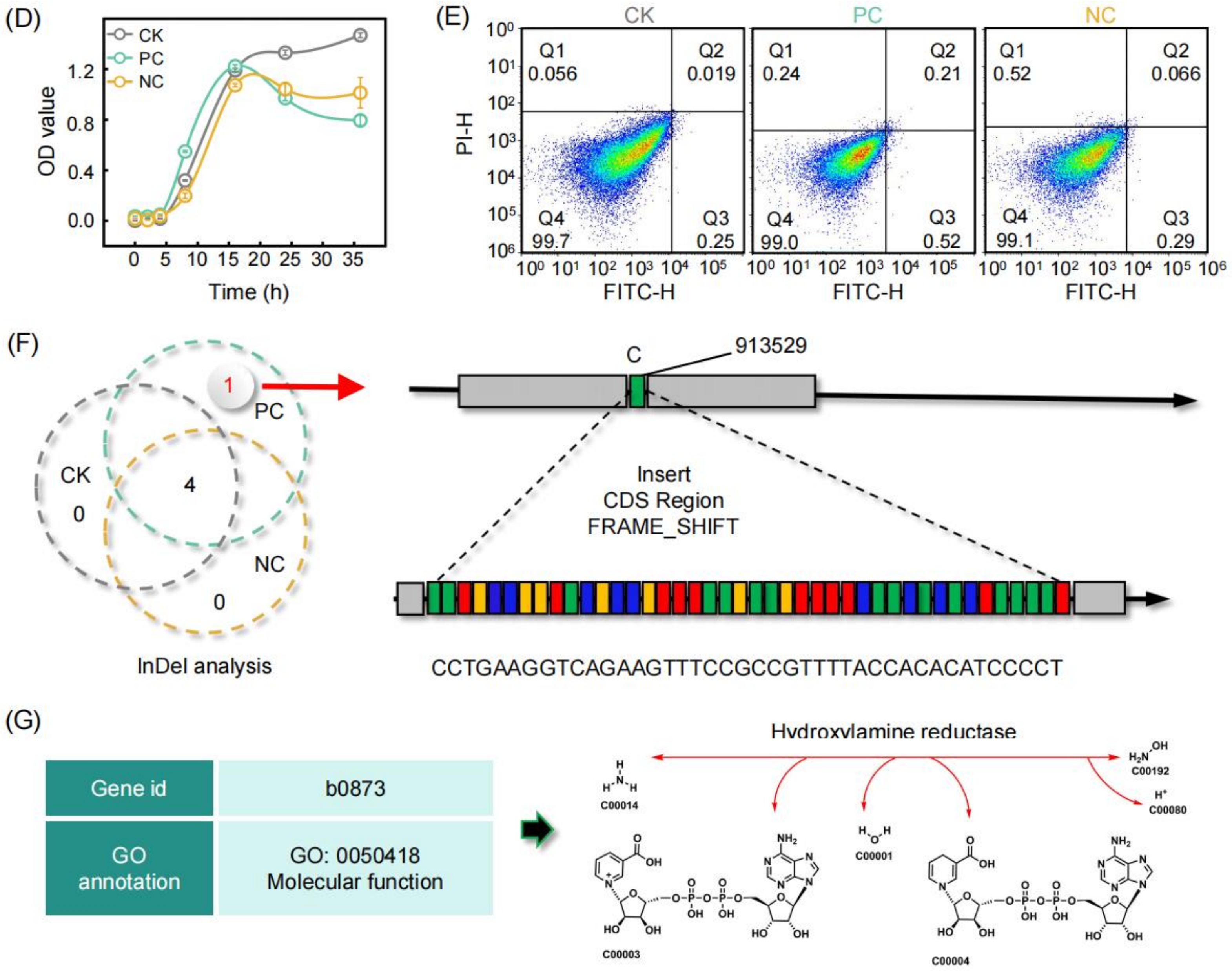
Interaction between NPs with different surface charges and *E. coli*



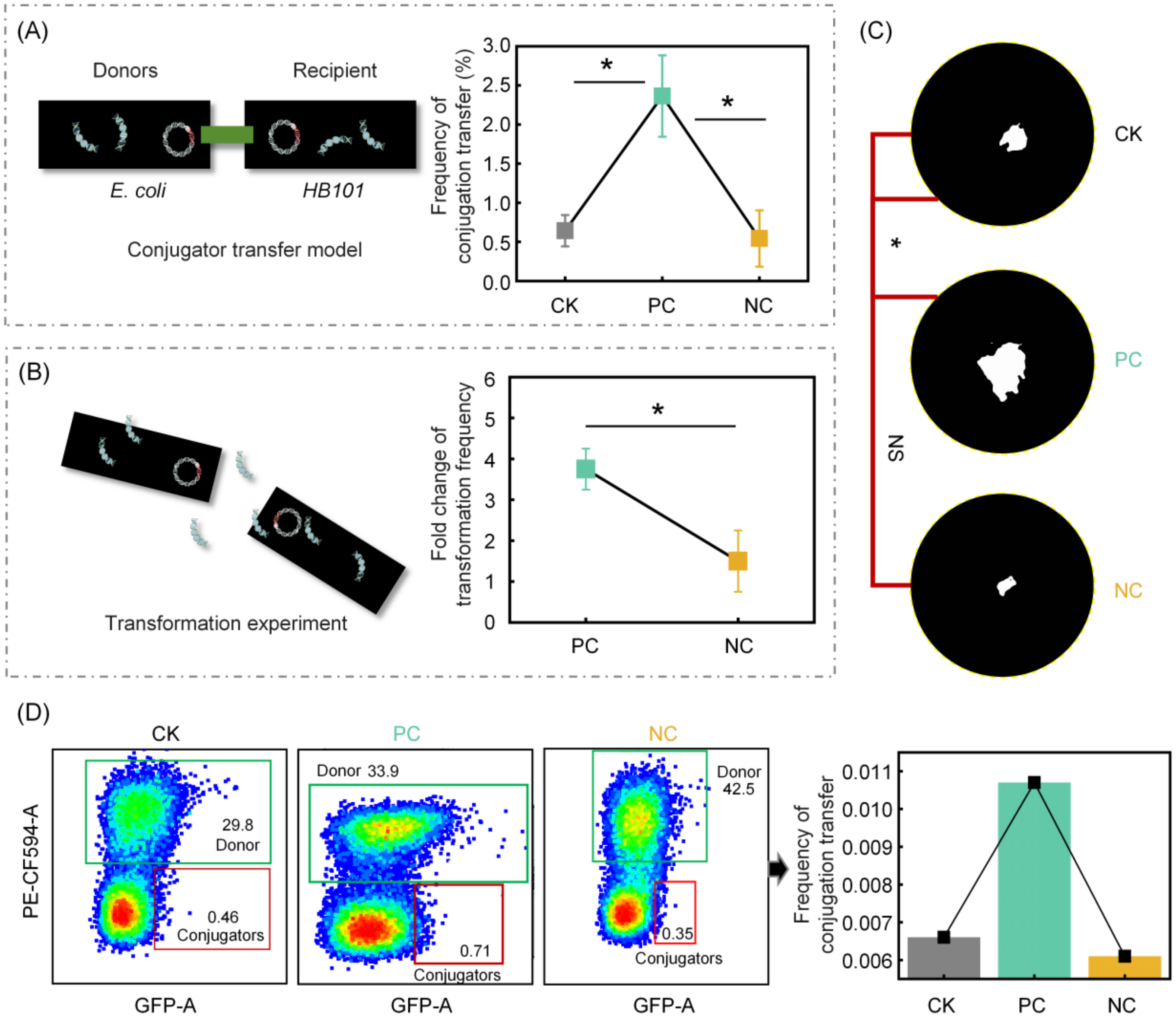
Transcriptomic and proteomics insights into antimicrobial resistance triggered by different charged NPs



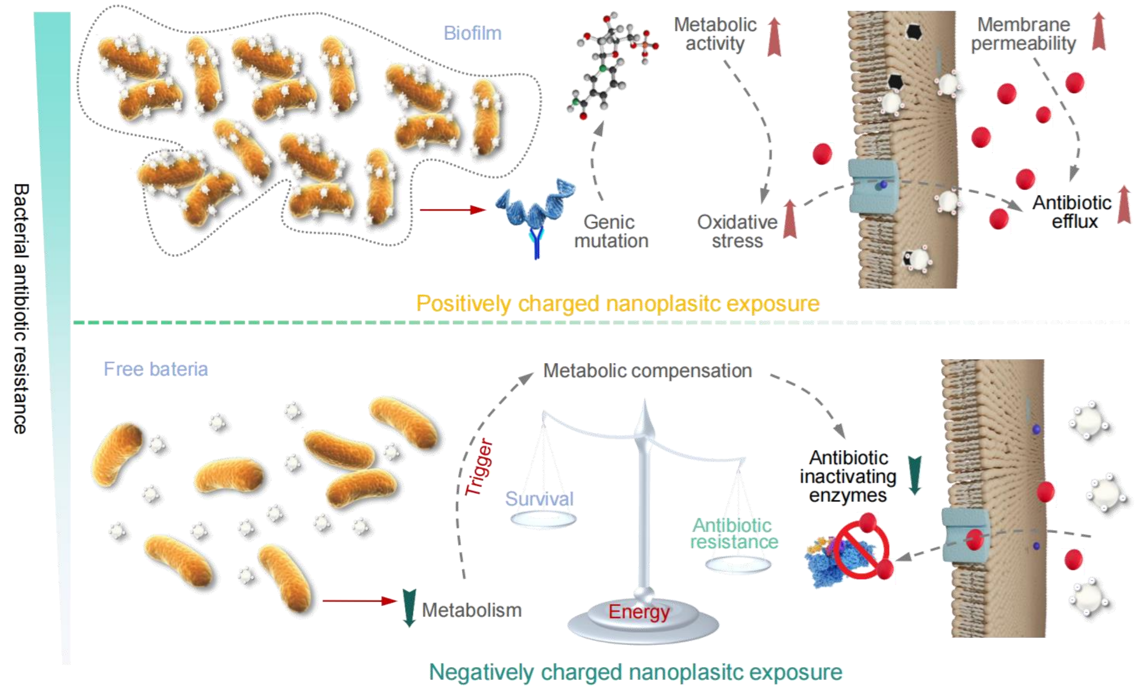
Genetic recombination plasmid replication of *E. coli* was triggered by PC-NPs



HGT in *E. coil* was enhanced by NPs with positive surface charges



Conclusions



- High concentrations (50 mg/L) of nanoplastics significantly increased antibiotic resistance in *E. coli* K12
- Positively charged nanoplastics significantly increased antibiotic resistance by enhancing oxidative stress tolerance and antibiotic efflux pump activity.
- Negatively charged nanoplastics inhibited resistance by disrupting biofilm formation and metabolism, potentially forcing bacteria to lose resistance as a survival strategy.
- Positively charged nanoplastics also promoted both vertical transmission and horizontal gene transfer of antibiotic resistance genes, escalating the risk to human health.

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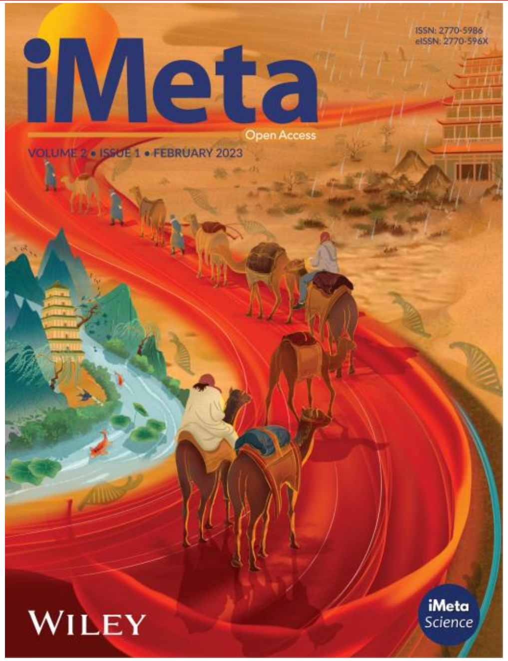

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